



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|------------------------|------------------|
| 10/083,200 | 02/26/2002 | Daniel G. Nocera | 020022 | 5682 |
| 26285 | 7590 | 04/15/2004 | | |
| KIRKPATRICK & LOCKHART LLP 535 SMITHFIELD STREET PITTSBURGH, PA 15222 | | | EXAMINER WONG, EDNA | |
| | | | ART UNIT 1753 | PAPER NUMBER |
| DATE MAILED: 04/15/2004 | | | | |

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/083,200 | Applicant(s) NOCERA ET AL. | |
| | Examiner Edna Wong | Art Unit 1753 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-65 is/are pending in the application.
4a) Of the above claim(s) 21-27 and 31-44 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1,5-20,28-30,45 and 49-65 is/are rejected.
- 7) ☒ Claim(s) 2-4 and 46-48 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>5/23/03</u> . | 6) <input type="checkbox"/> Other: ____ |

Election/Restrictions

Applicant's election without traverse of Group I, claims **1-20, 28-30 and 45-65**, in the Response to the Restriction Requirement dated March 30, 2004 is acknowledged.

Accordingly, claims **21-27 and 31-44** are withdrawn from consideration as being directed to a non-elected invention.

Specification

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

The abstract of the disclosure is objected to because:

- (a) the abstract is more than one paragraph long; and
- (b) line 11, the word "on" should be amended to the word -- one --.

Correction is required. See MPEP § 608.01(b).

Claim Objections

Claims 4, 6, 48, 50 and 63 are objected to because of the following informalities:

Claim 4

line 2, it is suggested that "2,3" be amended to -- 2,3- --.

Claim 6

line 2, the word "irridium" should be amended to the word -- iridium --.

line 2, the word "paladium" should be amended to the word -- palladium --.

Claim 48

line 2, it is suggested that "2,3" be amended to -- 2,3- --.

Claim 50

line 2, the word "irridium" should be amended to the word -- iridium --.

line 2, the word "paladium" should be amended to the word -- palladium --.

Claim 63

line 5, the word "corrindate" should be amended to the word -- coordinate --.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

I. Claims **28-30** are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for irradiating to photoexcite the photocatalyst, does not reasonably provide enablement for irradiating to thermally heat the photocatalyst. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Claim 28, line 2, recites “irradiating a transition metal complex”. The claim is open to any kind of irradiation. However, Applicants’ specification discloses photoexciting the photocatalyst. There is no disclosure in the specification of irradiating the photocatalyst with a heater to thermally heat the photocatalyst.

II. Claims **7, 8-16 and 49-65** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7

line 1, “the catalyst” lacks antecedent basis. Is this the same as the photocatalyst?

Claim 8

line 1, "the catalyst" lacks antecedent basis. Is this the same as the photocatalyst?

Claim 13

lines 2-3, it is unclear why fluorine and chlorine are listed as separate species when "halogen" is claimed.

Claim 14

line 1, "the ligand" (singular) lacks antecedent basis.

Claim 16

line 1, "the ligand" (singular) lacks antecedent basis.

Claim 49

line 2, it is unclear how the photocatalyst comprises a multinuclear (includes more than 2) transition metal core when it is required to have a binuclear transition metal core (from claim 45, line 6). See also claim 50, line 1.

Claim 51

line 1, "the catalyst" lacks antecedent basis. Is this the same as the

photocatalyst?

Claim 52

line 1, "the catalyst" lacks antecedent basis. Is this the same as the photocatalyst?

line 3, it appears that "a binuclear transition metal core" is the same as that recited in claim 45, line 6. However, it is unclear if it is. If it is, then it is suggested that the word "a" be amended to the word -- the --.

line 4, it appears that the "ligands" are the same as the at least one chelating ligand recited in claim 45, lines 7-8. However, it is unclear if they are. See also claim 53, line 1; claim 54, line 1; and claim 55, line 1.

Claim 58

line 1, "the ligand" (singular) lacks antecedent basis.

Claim 60

line 1, "the ligand" (singular) lacks antecedent basis.

Claim 61

line 3, it appears that the “two charged ligands” are the same as the at least one chelating ligand recited in claim 45, lines 7-8. However, it is unclear if they are.

Claim 62

line 1, it appears that the “at least one chelating ligand” is the same as that recited in claim 45, lines 7-8. However, it is unclear if it is. If it is, then it is suggested that the word -- the -- be inserted after the word “wherein”.

Claim 63

line 2, it appears that the “exposing” is the same as that recited in claim 45, lines 10-11. However, it is unclear if it is.

lines 2-3, it appears that the “radiation capable of photoexciting the photocatalyst to produce hydrogen” is the same as that recited in claim 45, lines 10-11. However, it is unclear if it is.

Claim 64

lines 1-2, it is unclear how the photocatalyst is in a valence-symmetric state when it is required to have the photocatalyst in a two electron mixed valence state (from claim 61, lines 1-2).

Claim 65

line 2, it appears that the "photoexciting" is the same as that recited in claim 45, line 10. However, it is unclear if it is.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

I. Claims **1 and 5-15** are rejected under 35 U.S.C. 103(a) as being unpatentable over **MacQueen et al.** ("Competitive Hydrogen Production and Emission Through the Photochemistry of Mixed-Metal Bimetallic Complexes", Inorganic Chemistry (no month, 1990), Vol. 29, No. 12, pp. 2313-2320).

MacQueen teaches a process, comprising:

(a) providing a reaction medium comprising:

a protic solution (= acetone) [page 2317, left column, lines 35-39]; and
a photocatalyst capable of a two electron reduction of hydrogen ions (= $[\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

(b) exposing the reaction medium to radiation capable of photoexciting the photocatalyst to produce hydrogen (= 405 nm) [page 2317, left column, lines 35-39].

The photocatalyst capable of a two electron reduction of hydrogen ions

comprises a multinuclear transition metal core ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The multinuclear transition metal core comprises at least one of rhodium, iridium, platinum and palladium ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The catalyst capable of a two electron reduction of hydrogen ions further comprises at least one of triphenyl phosphine, carbon monoxide, bis(difluorophosphino)methyl amine, MeCN, a phosphazene based ligand and a two electron donor ligand ($=$ triphenylphosphine) [page 2314, right column, lines 1-4].

The catalyst capable of a two electron reduction of hydrogen ions comprises: a binuclear transition metal core; and ligands capable of stabilizing a two electron mixed valence state of the binuclear transition metal core ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The ligands comprise: at least two π -acid groups capable of coordinating with the binuclear transition metal core; and at least one Lewis basic atom or group ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The ligands comprise: at least two π -donating groups capable of coordinating with the binuclear transition metal core; and at least one Lewis acidic atom or group ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The ligands comprise a phosphazene group ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The ligands comprise a group capable of giving at least one phosphorous atom

of the phosphazane group strong π -acid characteristics (= $[\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The group capable of giving one phosphorous atom strong π -acid characteristics comprises at least one of halogen, fluorine, chlorine, halogenated alkanes, halogenated alkenes, aryl substituted with electron withdrawing groups, and alcohols (= $[\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The ligand comprises a group attached to a nitrogen atom of the phosphazane group which allows participation of a lone pair of electrons to participate in π -bonding (= $[\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The group attached to a nitrogen atom comprises at least one of substituted or unsubstituted C_1 - C_{10} alkyl groups, methyl, ethyl, propyl, butyl, pentyl, hydrogen and a substituted phenyl, wherein the alkyl group is selected from branched and unbranched alkyl groups (= $[\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

MacQueen does not teach a coproduct trap.

However, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the process of MacQueen by adding a coproduct trap to the reaction medium because it is well within the ordinary skill of the artisan to have complexed the by-products of the reaction

with a constituent that would have prevented them from reacting competitively with the reactants that would have formed the desired product.

II. Claims **17-20** are rejected under 35 U.S.C. 103(a) as being unpatentable over **MacQueen et al.** ("Competitive Hydrogen Production and Emission Through the Photochemistry of Mixed-Metal Bimetallic Complexes", Inorganic Chemistry (no month, 1990), Vol. 29, No. 12, pp. 2313-2320).

MacQueen is as applied for the reasons as discussed above and incorporated herein.

MacQueen also teaches wherein the ligand has strongly π -acidic phosphine group ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

III. Claims **45, 49-59 and 61-65** are rejected under 35 U.S.C. 103(a) as being unpatentable over **MacQueen et al.** ("Competitive Hydrogen Production and Emission Through the Photochemistry of Mixed-Metal Bimetallic Complexes", Inorganic Chemistry (no month, 1990), Vol. 29, No. 12, pp. 2313-2320).

MacQueen is as applied for the reasons as discussed above and incorporated herein.

MacQueen also teaches wherein the ligand comprises a group attached to a nitrogen atom of the phosphazane group which allows participation of a lone pair of

electrons to participate in π -bonding ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The photocatalyst is in two electron mixed valence state and the photocatalyst further comprises: two charged ligands coordinated to the transition metal in the higher oxidation state ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

At least one chelating ligand is coordinated to the transition metal in the lower oxidation state ($= [\text{RhH}_2(\text{PPh}_3)_2]_2(\text{ddp})^{2+}$) [page 2315, Table 1].

The process further comprises: forming of a photocatalyst to a valence-symmetric state; and rearranging the chelating ligand to coordinate with both transition metals of the binuclear core (pages 2314-2315, "Experimental Section").

The protic solution is a hydrohalic acid (= acetone) [page 2314, left column, lines 37-40] and the photocatalyst in a valence-symmetric state comprises four halogen atoms ($= [\text{RhH}_2(\text{PPh}_3)_2]_2\text{L}(\text{PF}_6)_2$) [page 2314, right column, lines 46-51].

MacQueen does not teach photoexciting the photocatalyst in a valence-symmetric state to eliminate two of the halogen atoms and regenerate the photocatalyst capable of a two electron reduction of hydrogen ions.

However, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the process

of MacQueen by photoexciting the photocatalyst in a valence-symmetric state to eliminate two of the halogen atoms and regenerate the photocatalyst capable of a two electron reduction of hydrogen ions because MacQueen appears to disclose a process at least in a similar manner as instantly claimed. Therefore, it would have been within the skill of the artisan to expect that the photoexcitation of the photocatalyst in a valence-symmetric state disclosed by MacQueen would have eliminated two of the halogen atoms and regenerated the photocatalyst capable of a two electron reduction of hydrogen ions, unless proven otherwise.

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter:

Claims **2 and 3** define over the prior art of record because the prior art does not teach or suggest the process of claim 1, wherein the protic solution comprises at least one of hydrohalic acid, a silane, and water.

Claim **4** defines over the prior art of record because the prior art does not teach or suggest the process of claim 1, wherein the coproduct trap comprises at least one of tetrahydrofuran, silane, isopropanal, dihydroanthracene and 2,3 dimethylbutadiene.

Claim **16** defines over the prior art of record because the prior art does not teach or suggest the process of claim 10, wherein the ligand comprises a boron bonded to two nitrogen atoms.

Claims **28-30** define over the prior art of record because the prior art does not teach or suggest a process comprising the steps of irradiating a transition metal complex comprising: two rhodium atoms, three bis(difluorophosphine) methyl amine ligands, and triphenyl phosphine; in a solution comprising hydrohalic acid and a halogen trap.

Claim **46 and 47** define over the prior art of record because the prior art does not teach or suggest the process of claim 45, wherein the protic solution comprises at least one of hydrohalic acid, a silane, and water.

Claim **48** defines over the prior art of record because the prior art does not teach or suggest the process of claim 45 wherein the coproduct trap comprises at least one of tetrahydrofuran, silane, isopropanol, dihydroanthracene and 2,3 dimethylbutadiene.

Claim **60** defines over the prior art of record because the prior art does not teach or suggest the process of claim 54, wherein the ligand comprises a boron bonded to two nitrogen atoms.

The prior art does not contain any language that teaches or suggests the above. Therefore, a person skilled in the art would not have been motivated to adopt the above conditions, and a prima facie case of obviousness cannot be established.

Claims 2-4 and 46-48 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 16 and 60 would be allowable if rewritten to overcome the rejection(s)

under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Claims 28-30 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, first paragraph, set forth in this Office action.

Citations

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

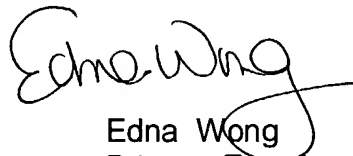
Gratzel et al. (US Patent No. 5,223,634) is cited to teach that visible light induced generation of oxygen from water using $L_2(H_2)Ru-O-Ru(H_2O)L_2$ (col. 12, Example VIII).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 5:00 pm, alt. Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Edna Wong
Primary Examiner
Art Unit 1753

EW
April 13, 2003